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Evaluation of Project Management Areas Applied in Aviation Industry

Zhodnocení oblastí projektového managementu aplikovaných v leteckém průmyslu

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Contents

1 Introduction

Lead times, high risk, scope, management of time, on-site representative, redelivery, engineering are the words can be heard in connection to every field in aerospace. For many people, specialists, aviation is a different world which complexity brings a beautiful but challenging business model. Moreover, the general business processes described by specialists in the field of management look different when adjusted to the aeronautical needs.

The goal of this thesis is to evaluate project management knowledge areas that are applied in business and their unique features that are typical in aerospace. Base for the evaluation is description of a company – Lufthansa Technik (LHT) which is one of the best known Maintenance, Repairs and Overhaul (MRO) provider in the field – and general description of their processes. Thesis consists of general knowledge on the company, project management and example of a typical application process scheme with an adjustment to aerospace and an example of a project performed in the past by Lufthansa Technik Shannon Limited (LTSL).

In the second chapter of the thesis, there is visible a full description of a model company in the industry. LTSL is placed in the environment, and described as a powerful industrial unit. Some of the company history, geographical locations, general financial facts, corporate structure and some standards which motivate its presence in the international market are also described and presented on examples and it is to provide with some typical information about this kind of a company, in this certain environment. The characteristics of LHT are equivalent to other MRO's in the industry, with some minor changes. The example is meant to give a clear picture of processes occurring in aeronautical field and show a routine of management.

On the other hand, chapter three is a theoretical element which actually shows some general theories of project management and simple examples of how the general theory can be adjusted to aerospace issues. There is presented knowledge how the projects are developed, their nature based on phases of life cycle, work breakdown structure or structure of stakeholders. Typical project management areas such as project integration management, management of time and scope, cost management, quality, human resource management and communications and risk mitigation and their methods of application are also described and presented on some practical examples from the industry. Company goals, mission and vision are transferred into some actions with the usage of management.

Having some basic knowledge on management of projects, aviation processes and typical industry characteristics, chapter four contains evaluation of a simplified project which is to show the real application of theory in practice. By presentation of a simplified maintenance event of an aircraft belonging to Customer X, phases and areas of management characteristics for aerospace are applied with special adjustment of the theory. Even though, the data used in the example is simplified, the description of LTSL's performance in every project phase is visible and allows to evaluate and distinguish the areas of project management unique for aviation from the other areas commonly applied in every other industrial environment, enables to understand what kind of improvements could be implemented and an example of research that could be organized to help the company improve its functions and increase revenue.

2 Presentation of the company

The second chapter of the thesis contains a theoretical-methodological part which is to present and describe a company – Lufthansa Technik as a whole and in more detail, its facility Lufthansa Technik Shannon Limited as an industry player. It is also to give introduction to the aerospace industry. It is to show how a very well know but typical aeronautical party was developed and organized. The way it is acting in the industry and how it is built, what kind of specialist are working on its success and profit, how they are qualified and trained. How the company operates – either with or without constraints. What is its exact subject of expertise, what kind of approvals have to be implemented, what authorities make sure the process is followed accordingly.

This chapter is to describe the firm and give a real base for the whole project as after the description there is a theoretical part of processes described, planning, tools and specific data application for an aircraft maintenance project and moreover it is all described, applied and evaluated in further steps..

To start with, it is valid to mention the mission, vision and core values of Lufthansa Technik. Specialists from the company do believe they work for a leading provider of aircraft-related services that are not tied to a specific manufacturer.

Referring to the LHT's Internet sources (*www.ltp.com.ph/Pages/Content.aspx?cid=5*), the long term target for the company is to become an MRO of first choice in the region of operation. As a mission ensuring of safety and reliability for the customer is understood. A matter is also fulfilment of customers' requirements, the conformance with legal and public regulations and internal corporate standards. Customers are to receive some tailored solutions in the range from a single supplier in the fields of maintenance management, aircraft (A/C) and component maintenance, component production and design. This includes the utilization of the most modern repair methods for maintenance. For the shareholders, however LHT achieve a sustained increase in value through excellent returns and stable growth within the international group. The employees are conscientious, quality and performance - oriented.

For Lufthansa group, as a key participant of aeronautical industry, safety is the core value and is given top priority within the business. This not only applies to the A/C, power plants and components that are entrusted to them, but also to the environment and the prevention of work-related accidents and illnesses of the employees. The mentioned safety policy is communicated to all levels of the organization to achieve the highest delivery of

safety performance of all employees. Referencing Altfeld (2010), the highest possible safety is one of the most important aspects of any aeronautical commercially developed projects; this is to minimize the accidents which potentially as a consequence generate vast insurance cases and lead to disruption of company's good name as a safe service provider. The technical and managerial complexity in aviation lead to creation of many systems and subsystems which help to keep track of every project stage and in case of a failure, there is no harm made in the program as a whole. Mentioned by the author, one idea of Boeing *(www.boeing.com)* is to create events with no possibility of single failure modes which means the solutions used in aviation have to be designed in a way where a partial system or structural failure can never result in a catastrophic outcome. MRO providers copy the Boeing's idea and apply it in management and maintenance organization.

Having privilege of observing Lufthansa specialists, can be understood they are not just satisfied with what they have already achieved even though the brand is very well known and internationally recognized. They constantly strive for continuous improvement for which various benchmarks and Key Performance Indicators (KPIs) together with audits are used and performed. As mentioned by Alfeld (2010), the complexity of processes demands constant measurement. KPIs function according to the author has to be highlighted as at this business level, they can improve process efficiency and shorten possible lead times which are directly connected with Aircraft On Ground (AOG) costs.

Within Lufthansa Group, creative thinking, potential and knowledge are encouraged and highly developed. Lufthansa Group invests in their people. The environment is open for impulses from the outside and in-house. Mentioned Alfeld (2010) claims, aerospace industry is one of the industries, together with the chemical industry, which is always in a high risk of dramatic changes. As an example, an airplane crash caused by a maintenance mistake can lead both to bankruptcy of the airlines and MRO provider which did not fulfil the standards. Therefore, the party has to be as flexible in its operations as possible and on the other hand, as professional and strict as the controlling authorities demand.

2.1 The history of Lufthansa aircraft services

There was a long way from mentioned by Carvill (1993) first powered flight by Wright brothers in 1903, to shaping and creation of Lufthansa Technik's roots and that goes back to the founding of the new Lufthansa in the early fifties. According to Lufthansa's sources

(www.lufthansa-technik.com/history), after the four allies dissolved the old Lufthansa in 1951, a successor company was founded just two years later.

The second half of the twentieth century was the time when the foundation was laid for the new airline's technical base in western Hamburg. According to the sources, the first double hangar was already able to accommodate three four-engine propeller-driven Super Constellations exactly at the time when Deutsche Lufthansa AG began its scheduled flight service on 31 March 1955. Only a few years later, construction of two additional hangars began as there was a need for the workshop area expansion by an engine shop with an electroplating facility and an office area as well.

After Lufthansa's first Boeing 707 arrival in Hamburg, the Frankfurt airport was to become the future home base of the new long-haul jets. Lufthansa began to expand and building a maintenance base at Rhine-Main airport. Frankfurt subsequently start to become the most important hub in Lufthansa's network and the centre for daily maintenance.

According to Federal Aviation Administration (FAA), the U.S. FAA *(www.faa.gov),* was the first who fully authorized Lufthansa's engineering division to service the aircraft and engines of American airlines. Even then Lufthansa's engineers were developing their own repair procedures that attracted airlines from all over the world to Hamburg.

Even during its first twenty years the Lufthansa facilities were in danger of the European crisis, despite the economic setbacks caused by the oil crises of the seventies, the volume of incoming orders kept growing at double-digit the technology described by Groenewege (1998/1999) was flourishing and the company highly respected by its customers. The biggest boost came from the ATLAS Group, also mentioned by the mentioned author, an alliance of Lufthansa with Air France, Iberia, Alitalia and Sabena.

Because of the constant grow, and development of the A/C providing companies, microelectronics and new-style computers began appearing onboard, requiring new maintenance procedures. It gave room for heavy and light maintenance development and Lufthansa Technik overtook the niche.

Presented by Masaaki (1997), *'simple'* commonsense and low-cost approach to management, lead to the expansion of Lufthansa's engineering division in the eighties. Also another side of the business was introduced, and as per the Internet sources of Lufthansa *(www.lufthansa-technik.com),* it was a new painting hangar which was built to meet modern aircraft painting needs in a manner protective of the environment. Another new brand awareness began to develop.

The Group's bureaucratic structures seemed too cumbersome, especially in the light of the economic slowdown and growing international competition in the air transport sector. And the reorganization itself was considered as one of the biggest challenges facing the industry together with safety and sustainability, described by Shankman (2014). In Lufthansa, departments were reorganized into self-contained divisions that would market their own services independently.

According to the historic fall of the Berlin wall, Germany was reunited and also Lufthansa returned to Berlin where another MRO facility was set up.

As an example of great adaptation skills and flexibility, the Lufthansa Group to keep its competitiveness, broke up into seven separate operating divisions which are widely described by Lufthansa's websites (www.lufthansa-technik.com). Moreover, an engineering division was converted into an independent stock corporation under the name Lufthansa Technik and it was very short before the 40th birthday of Deutsche Lufthansa AG.

Nowadays the company offers an Total Technical Support (TTS) which is used by more and more airlines from all over the world knowing the services of LHT as very experienced with great aviation mechanics and engineers.

Lufthansa Technik is certified as an design organization and also as a manufacturer of aircraft parts in addition to its competence in commercial aircraft overhaul. It is a kind of triple capability which allows for a highly growing potential for developing of new products, project divisions and solutions with various service lines.

Since its founding, LHT has become the world's leading provider of commercial aircraft services. Company acts accordingly with the principle they have to be where the customers are. Its international presence in the world's regional and global air transport markets is the root, rock and foundation for its further development.

2.2 Locations

It is generally known Lufthansa Technik network is made up of specialists that successfully offer the world's airlines new and valuable services. Meanwhile, it is valuable to highlight that the network itself consists of more than 30 operating subsidiaries and affiliates in every continent. Europe, Asia, and the United States are locations for the biggest MRO facilities. Even though Lufthansa Technik is commonly known and recognised the main strategy presents a consistent need of an expansion and growth and its international alliance

makes the company more competitive on several fronts – for instance both European and Asian or American. Moreover, on the one hand, the company can now operate as a regional provider and on the other, using the various regional advantages the company uses benefits from its effect on the costs. Thanks to this idea, LHT promotes continuous development of new products and services either by the foreign facilities or back at its home base in Germany.

Lufthansa Technik provides with various range of services such as Aircraft Base Maintenance (Bulgaria – Sofia, China – Beijing, Germany – Hamburg/Frankfurt, Hungary – Budapest, Ireland – Shannon, Malta – Luqa, Philippines – Passay City, Puerto Rico – Aguadilla), Aircraft Component Services, Aircraft Line Maintenance, Composite Repairs, Engine Parts Repair, Engine Services, Landing Gear Services, Painting, Supplementary Services, VIP and Special Mission Aircraft Services. In this thesis, Aircraft Base Maintenance is described and the picture applies to facility in Shannon, Ireland.

2.3 Facts and figures

From the Internet sources *(www.lufthansa-technik.com)* and information presented by Lufthansa Technik AG Quality Management (2016), comes an information about the formal establishment of company in 1994 as a wholly owned subsidiary of Deutsche Lufthansa AG. Lufthansa Technik Shannon is the lead member of the Lufthansa Technik Group which encompasses 30 subsidiaries and more than 26,000 employees worldwide.

Generally, Lufthansa Technik provides staff working at 60 line maintenance stations worldwide handling about 1,700 aircraft inspections daily. As per the Internet sources *(www.lufthansa-technik.com/facts-and-figures*), Lufthansa Technik supplies more than 2,000 aircraft with spare parts and offers maintenance and overhaul services for about 30 aircraft types and variants. From the technical point of view, about 40 A/C engine types can be serviced and the Component Services Division can handle more than 300,000 components annually. Lufthansa Technik also presents a wide portfolio of more customised and less commercial services such as A/C Total Support Services such as A/C Leasing and Trading Support, AOG support, VIP Completion Centres.

As considered by specialists from Lufthansa, 2014 was a good year for aviation and therefore a development of the company could have been reached. According to the company website mentioned, it marked the 100th anniversary of commercial air travel, and 3.3 billion

passengers took advantage of the occasion to fly. Because the demand rose considerably, nearly 6 percent growth could have been observed and it exceeded the average over the last ten years. Disproportionate growth the industry was enjoyed in regions such as Asia or the Middle East and that was countered by growth constraints in Europe, including aspects such as taxes, infrastructural limitations and rigid regulations.

Lufthansa Technik strengthened its competitiveness in 2014 and paved the way for sustainably profitable growth in line with its strategic fields of action for growth, quality and innovation.

Even though the growth was observed as presented in Tab. 2.1, the fluctuations in aviation industry are significant and the changes can be major and occur in very short time period. Altfeld (2010), argues that an aerospace party can be easily put in menace caused by either problems with financing, high development expenses or too low revenues which are either incorrectly assumed or changes in acceptance criteria by authorities.

Tab. 2.1 Lufthansa Technik Annual Report for years 2013 and 2014

Criterion	**Unit**	**Value in 2014**	**Value in 2013**
Revenue	Thousands of Euro	4,336,848	4,180,288
Result from operating activities	Thousands of Euro	335,091	466,455
Earnings Before Tax	Thousands of Euro	320,116	456,226
Operating profit	Thousands of Euro	391,973	404,048
Investments	Thousands of Euro	117,644	135,682
Depreciation on assets	Thousands of Euro	93,218	98,740
Balance sheet total	Thousands of Euro	3,897,765	3,458,733
Employees (year average)	Number of employees	20,085	19,927
Personnel costs	Thousands of Euro	1,186,093	1,227,384

Source: www.lufthansa-technik.com (2016)

2.4 Corporate structure

Described by International Labour Office (1992) corporate structure, partly can be understood as a way in which an organization is defined. Sometimes the general structure includes all departments such as Continuous Airworthiness Maintenance Organization (CAMO), Finance, Controlling and Business Development, Material Management, Planning and Engineering, Quality, Network Sales and Customer Service, Aircraft Modification, Base Maintenance Services Office, Paint, Human Resource in as it is in LTSL.

The Lufthansa's picture is highly complex as it is mixture of structures named by specialists such as Divisional, Matrix, Project Organization Structure and Functional. Own observations allow for understanding, the company's local structure is rather complicated and it is a mixture of four mentioned types.

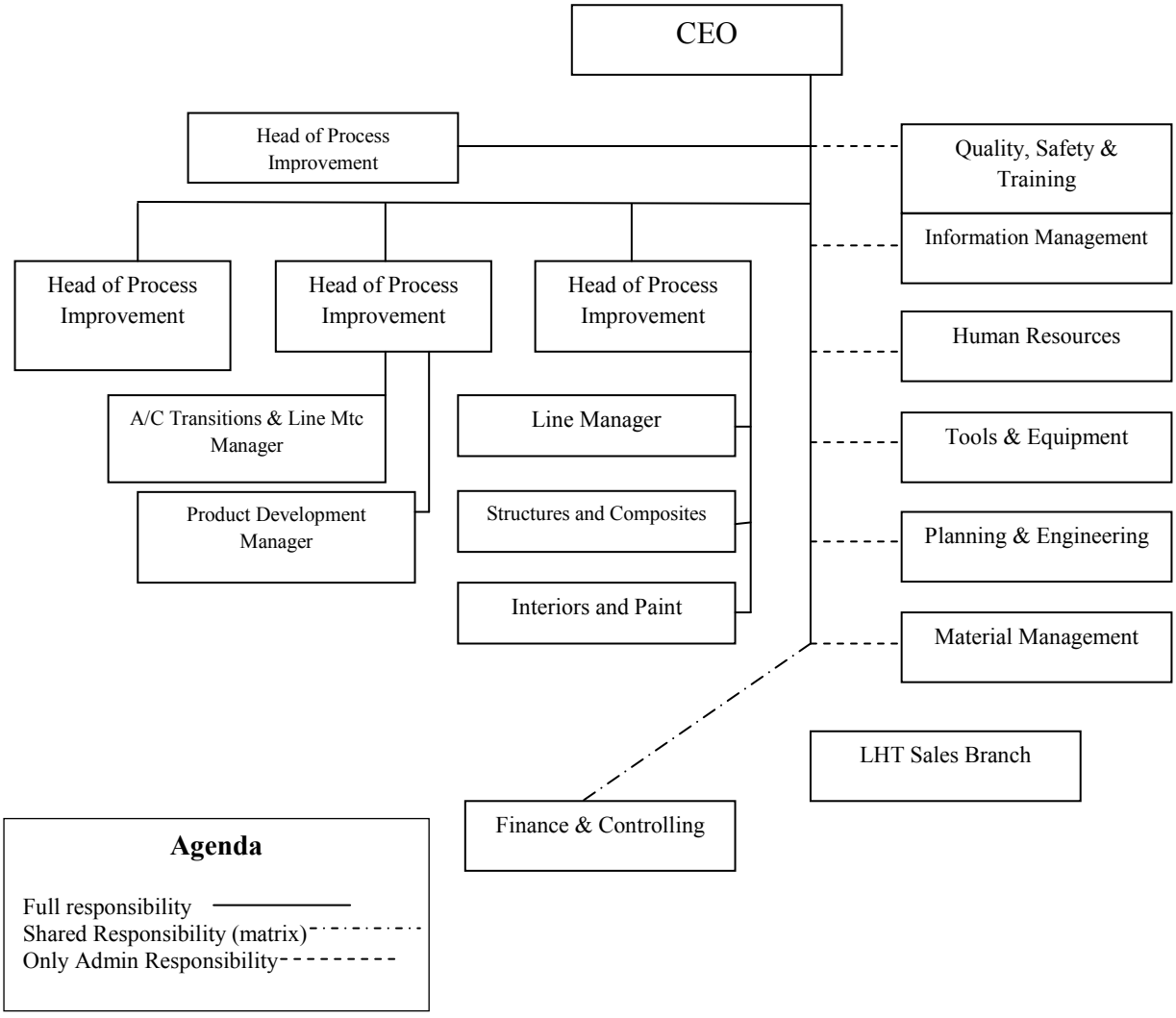
LTSL applies the divisional structure in consideration to project teams as the production is divided into six bays – maintenance lines. There is a project manager responsible for each line, and each team consists of a materials coordinator, a planning engineer, lead engineer assigned to every work station which are directly bounded with work areas such as avionics, cabin, engines, interiors, etc. From the functional structure, LTSL takes an organization of groups which perform similar tasks and for example, the quality department is organized in a way where there is a head of the department and deputies specializing in performance of similar duties. Complexity of the whole plan can be considered as the element of matrix structure; sometimes the teams are put together based on the number of members needed to complete a project – looking at the technical side of business, a big 28 days maintenance event – an Intermediate Layover Check (IL-check) for Airbus - can be imagined or a small 5 days light check – in both examples the number of staff needed will differ and so the team structure. Also according to the rules of matrix division, there are employees who belong to two or three projects at the same time. Those people in reality report to three different managers which can be very confusing and it is a huge drawback noticed by the employees.

There is also another way of presenting the structure which is dependent on the particular facility structure. As an example the facility in Shannon can be taken into account where matrix is applied.

Administrative responsibility in the company, described in Fig. 2.1., shows the responsibility can be either full like between Chief Executive Officer (CEO) and Head and

Process Improvement; shared like between CEO and Finance and Controlling Department or there can only be an administrative responsibility for example between CEO and Tools and Equipment Department or Head of Process Improvement and Line Managers.

Fig 2.1 Administrative responsibility of CEO in LTSL



Source: Own elaboration based on observations made in LTSL

Once the information flows, the employees know exactly who they report to and what they are expected to do. As addressed by Hill (2013), the managers have to ensure each individual's performance and record it so an appraisal can be assessed. Moreover, in understanding of the whole process, some of the job descriptions could be very useful. As an

example, a production manager's job description can be taken into account. In LTSL, project manager has to manage all aircraft on the bay and assigned commercial, standards and Turnaround Time (TAT) targets, ensure the customer is informed in a timely manner with the project status and that the key issues and actions being taken to resolve those issues. Newton (2015) goes even further and claims that project managers are the employees who are meant to establish, maintain and foster a culture and process or system of continuous improvement. Line managers also ensure the compliance with all regulations such as Part 145 or Environmental, Health and Safety (H&S) which have their own form in aerospace and are widely described by European Aviation Safety Agency (EASA) specialists (*www.easa.europa.eu*). As the mentioned managers can also deputise for the Head of Production and other production managers as required, it can be understood how important their role is in the whole organizational structure. Thanks to the managers, the line employees know exactly how to act. And thanks to the higher ranked specialists, the line managers know how to set up the production and which targets exactly have to be fulfilled.

To maintain the structure in LTSL there is a need for an efficient corporate knowledge data base. The above consists of process measurement database, project files, historical information and lessons learnt, issues and defect database and financial database. LHT created its own databases and systems for measuring the KPI's – System Analysis and Programming (SAP). SAP lets the managers technically prepare to every project, allows also to create financial sheets. As SAP is a hands on tool, there is also IQ Move system which actually explains all the procedures that have to be performed with the usage of SAP. As a support, there can also be LHT's E-Base mentioned which is some kind of a general knowledge database for the employees.

2.5 Subject of expertise in Lufthansa Technik Shannon Limited

Former Shannon Aerospace, LTSL company, specializes in the provision of Base Maintenance Services (BMS) on Boeing 737, 757 and 767, Airbus A319, A320 and A321 aircraft to the world's airline industry.

Former Shannon Aerospace holds both EASA and FAA approval. Lufthansa Technik Shannon Limited is fully equipped to perform heavy maintenance programmes on Boeing and Airbus aircraft. The party offers customers a range of technical services and support

delivered by their expert teams. What is a huge commercial advantage, LTSL specialize in End Of Lease (EOL) and handover projects.

According to websites *(www.lufthansa-technik.com*), Lufthansa Technik Shannon Limited has approximately 600 employees, and offers the following business units: aircraft base maintenance hangar including paint hangar which is no longer operating as it was recently converted into another base maintenance space, workshops, aircraft line maintenance station at Shannon Airport, associated administrative divisions, adequate office accommodation and secure storage facilities are provided for the above business units.

The mentioned services are targeted mostly to airlines, maintenance organizations and operators of business and VIP aircraft. LTSL also drafts, designs, produces, installs and maintains the complete interiors for their customers.

2.6 Keys to Lufthansa Technik's success

Malaval, Benaroya and Aflalo (2014) described the aerospace industry as the one with high level of technology, with a multitude of special skills for the design of highly complex aircraft, infrastructures and systems. According to the author, it is an industry with a never ending need of capital. Place where research and development are the key factors with a strategic importance of miniaturization, software development, calculations and alloys sectors.

Aerospace industry is a remarkably competitive environment with a number of companies operating and specializing in aircraft maintenance where a minor mistake can cause everything. As the most influential competition for Lufthansa there are considered companies, such as Iberia in Spain, EAS or Air France in France, TAP in Portugal, Turkish Technik in Turkey, Aerostar in Romania, MASCO in Lebanon, Haitec in Germany, Job Air in Austria.

Even though the environmental pressure can be sorely severe, over the past years the company has been developing and progressing. According to some research made withing the company employees, the company has been successful because their prices are not either too low or too high, the quality is outstanding and the brand very well recognized. Lufthansa Technik is a leading MRO provider worldwide. Employees describe Lufthansa Technik as a company which is vast, diverse and curious with high standards and still very proud.

Even though the aviation industry is considered as a homogenous market by Altfeld (2010), there is still enough space for competition. In heavy maintenance the products or services traded are very same, although there may be some minor differences in design – A/C type or check types. In aeronautical industry, the consumers have the opportunity to compare a wider range of options rather than being limited to one or two possibilities. This makes the industry very sensitive and dynamic.

Lufthansa Technik is flexible and well able to adopt changes very fast. Its good name and position in the market allow for fair pricing and outstanding quality.

As the marketing information is sensitive, the only visible trend seems to be the one coming from the seasonality of industry. In winter time - the prices can be slightly higher in Europe because the European customers want to do the maintenance when their airlines are not very busy with the holiday season, this trend does not apply to the African customer for example. Kongo Airlines will not be touched by this trend. If they wish to service their aircraft in Europe, they can wait until the summer time when the prices are lower as the demand is not that high. For the summer it is also very characteristic that the demand for cargo A/C maintenance is higher.

Lufthansa Technik sales team's main task is to keep the company slot schedule full and make sure the customers know about their capabilities.

According to Altfeld (2010), once an aerospace party has a fully satisfying customer's interface and is well able to fulfil the expectations its only requirement is to stay sensitive in the financing sphere and safe time sustaining the service quality. Observing LTSL, the described approach is valid. Thereupon, LHT project team not long ago introduced a revolutionary approach Six To One. Main target was to cope with the European industry challenges in the most efficient way; to increase the long- and medium-term competitiveness of the business and secure as well as enhance market share. A new organisation of six European facilities (Shannon, Sofia, Malta, Budapest, Hamburg, Berlin) with cross-border responsibilities was created. Centralised responsibilities for production support and sales were the main focus. In the other words, creation of bigger network took place which was based on standardizing and pulling resources where the power of six facilities was brought to one centre.

2.7 Safety standards

The importance of approvals and authorisations in the aeronautical industry is strongly linked with quality management demonstrated by Business Dictionary (www.businessdictionary.com/definition/quality.html). Its rapid development has been noticed after the end World War II. The new standards have evolved alongside technological advances and the increasing importance of providing consistent quality, and managers know it is critical to keep up with these changing needs.

Lufthansa Technik Group MRO companies, who perform aircraft, engine or component maintenance are already certified or will become certified in accordance with the standards such as AN/AS 9100/9110 Quality Management System – Requirements, ISO 14001 Environmental Management System – Requirements, OHSAS 18001 Occupational Health and Safety Management System, greenhouse gas emissions in accordance to regulation 2003/87/EG and the requirements of DIN EN ISO 9001, EN 9110, DIN EN ISO 14001 and OHSAS 18001 which are all listed by EASA (*www.easa.europa.eu*) or FAA (*www.faa.gov*) or other approval specialists.

To ensure the consistency of all processes, Lufthansa implemented IQ Move, which is a documentation system (see 2.4 Corporate structure). It involves description of all processes within the organization, consists of all legal requirements that apply to the maintenance, design and production organization as well as the continuing airworthiness management, legal requirements on environmental protection, requirements of oversight and reporting about greenhouse gas emissions in accordance to regulation 2003/87/EG and the requirements of DIN EN ISO 9001, EN 9110, DIN EN ISO 14001 and OHSAS 18001.

Even though Altfeld (2010) mentions US Federal Aviation Administration and the European Aviation Safety Agency as the two major institutions which monitor the design and development of any commercial A/C party, there are also other accountable centres such as International Civil Aviation Organisation (ICAO) - members are the sovereign countries. The main reason of ICAO according to the Internet sources *(www.icao.int*) is to make sure the international standards are harmonized. It gives a base for national rules and regulations worldwide. The organization provides with information on detailed technical rules, approval of operators, qualification and licensing of crews.

International Air Transport Association (IATA) is a trade association for airlines (*www.iata.org*) that supports areas of aviation and together with ICAO supports areas of aviation activity and helps to formulate industry policy on critical aviation issues.

The previously mentioned institutes and standards had direct impact on aircraft. Even though, the environmental safety impact is not direct, it has also a high importance in will minimizing any risk to the environment and prevent pollution as far as is practically possible. As described by Altfeld (2010), environmental safety can be one of the risks for our company and an adherence to all relevant environmental, legislative and regulations requirements can take a position of a key factor. Also one of the modern business models is seeking to reduce waste and conserve resources through the responsible use of energy and materials, seeking to reduce emissions to atmosphere and water through improved process control.

LHT is committed to the protection and enhancement of the environment and according to the websites (www.lufthansa-technik.com), it is an Intergovernmental Panel on Climate Change (IPPC) licensed company. They have implemented an environmental management system in accordance with its environmental policy and in October 1999 LHTL was awarded the ISO 14001 International standard. For more than a decade of operations there have been no incidents or accidents of environmental significance at company.

3 Description of project management knowledge areas in aviation industry

The entire third chapter of the thesis is to present and describe the general history of projects and methodology sufficient for managing of projects and its adjustment made by companies operating in airline or aerospace industry where timing, safety, highest quality and customers' satisfaction are the most relevant criteria.

It is necessary to highlight that even though project management rules are known as generally applied in all types of work places, the managers from aviation industry have to work with them in a special way to adjust the data and needs to the job specifications. In their case, sometimes one minute of a delay can bring either a huge financial or productivity loss.

Moreover, as already described aviation is one of the most regulated industries. Airlines operate within a quite demanding set of regulations, implementing rules and acceptable means of compliance with the goal to keep air travel safe and aircraft airworthy. Aircraft maintenance is undeniably a major factor to achieve safety and airworthiness. Beyond safety, the mission of aircraft maintenance is also to maintain reliability of the aircraft and all its inherit systems. Finally, aircraft safety and reliability are expected to be accomplished at a minimum total cost. It is opportune to perform regular maintenance to avoid unplanned aircraft unavailability.

Pointed out by Altfeld (2010), project management in aerospace differs from the general project management described by Project Management Institute (2013). In aviation, a high number of unknowns starts every project and typically they cannot be resolved in any of the early project planning phases however, during the execution phase itself, there are only a few unknowns.

In some other words, the aerospace industry is characterised by long lead times, large investments and high technological content. These variables affect all key players and their decisions, therefore the need for expert solutions has become a fundamental requirement. Sample aviation project can be development and implementation of fair competition policies, reductions of emissions, expansion of aviation facilities or reengineering the safety inspection processes – and this is the main field on which this thesis is focused.

Companies involved in this sector need to understand the big picture and have the capabilities to bring value as Offices of Emergency Management (OEMs) or at any stage in the supply chain. This unique mix of expert resources, along with an extensive project

portfolio and geographic coverage, positions the company in a very select group of businesses. It is one of LHT's goals to keep the strategic competency for organizations, enabling project results to tie with business goals, to fulfil the strategies and excel in the industries.

Referring to the total business complexity described by the aviation project manager Altfeld (2010), there are many aspects of the theory such as management complexity, monopsony complexity which is a market form where only one buyer faces many sellers, multi-cultural complexity, low frequency complexity, processes complexity, public relations complexity which have to be integrated in a very intelligent and pragmatic way and as an example can be LHT's Six to One where the weak sides of six facilities are combined and dealt with on a big scale and where the strong aspects of the business are even stronger and better presented all brought to one.

3.1 Development of projects theory

Some people believe the history of project management reaches 2570 BC when the Great Pyramid of Giza was completed. The Pharaohs built the pyramids and today the archaeologists still debate how they achieved this feat. Kozak-Holland (2011) mentions there were already some kind of managers back then who were planning, executing and overseeing ventures.

According to the historical author mentioned above, as a discipline, project management developed from several fields of application including civil construction, engineering, and heavy defence activity. It is believed, until 1900 projects were generally managed by creative people; architects, engineers or master builders themselves. It was in the 1950s that organizations started to systematically apply project management tools and techniques to complex projects. The 1950s marked the beginning of the modern project management era. It was not an ad-hoc basis anymore. Specialists started using tools and formal techniques.

Kozak-Holland (2011) presents Henry Gantt and Henri Fayol as recognised forefathers of project management. The first one is known from planning and control techniques, Gantt chart is a famous project management tool. The second one - created five management functions that form the foundation of the body of knowledge associated with project and program management. Other key contributors such as DuPont and Remington Rand

Corporations – Critical Path Method (CPM), Winslow Taylor – Work Breakdown Structure (WBS) and Resource Allocation or Booz Allen Hamilton – Program Evaluation and Review Technique (PERT) and many others have huge on the modern Project Management (PM).

Nowadays conventional is Project Management Institute (2013) idea that projects are means of achieving organization's strategic plan; the strategic considerations that are used are market demand, business needs, customer requests, legal requirements, etc. Projects convert an idea into reality.

3.2 Project nature

Studying from words of Project Management Institute (2013), can be learnt that every project has its nature which is indicated by a definite beginning and end. The end can be achieved when the project's objectives have been achieved or in some other cases, when the project is terminated. Following the existing procedures, Project Management Institute (2013), highlights that every project creates a unique product that can be either a component of another item or an end item in itself, a capability to perform a service or a result such as an outcome or a document which then has social, economic or environmental impact. Newton (2015), goes a little further in his beliefs and states that everything that an organization does can be categorised as a project or process, where process is something that happens continually and has low risk associated with it, even though it happens once, it has high level of risk.

There are many recognised various ways in which projects can be approached and host methodologies, frameworks have been developed over the past 60 years or so.

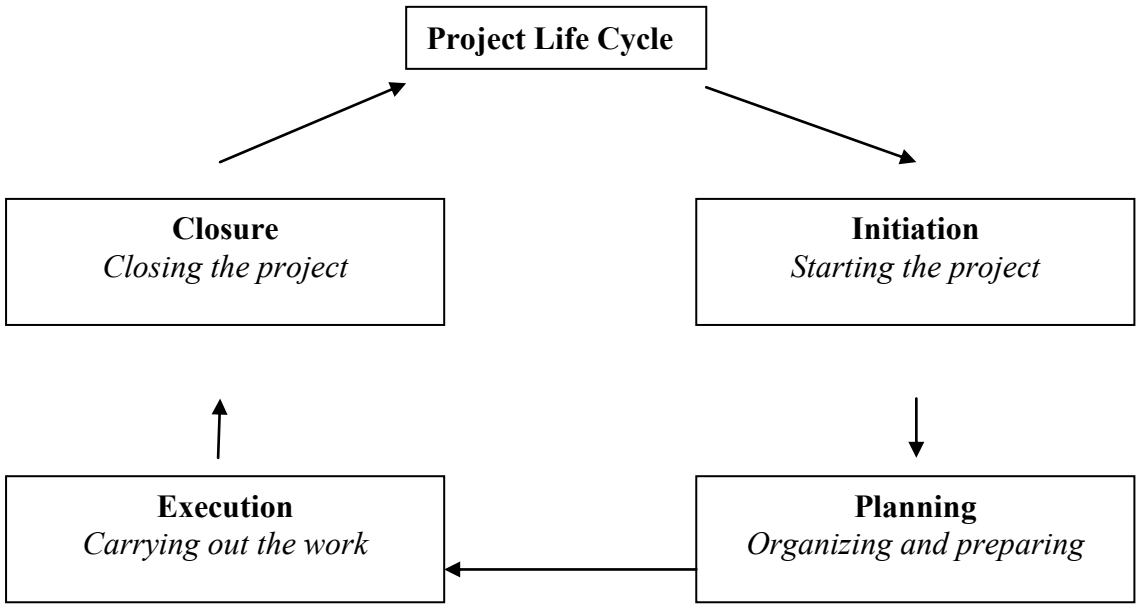
From the Kozak-Holland's (2011) idea, as an example can be given an approach such as PRINCE 2, COBIT, Critical Chain, PMBOK, Agile or Six Sigma which are recognized as the six most common approaches. Each of these approaches has its own way of looking at projects and its own terminology. And for example PRINCE 2 is a process-based approach for PM where the acronym itself stands for Projects in a Controlled Environment; Agile uses an iterative method of determining requirements for engineering and software development projects in a highly flexible and some kind of an interactive manner and PMBOK – a short for Project Management Body of Knowledge describes project management practices that are common to most projects, most of the time. Because of its versatility, PMBOK framework is widely applied and most of the interpretations included in this bachelor's thesis are based on

it. Observations help to understand that most of the companies operating in the aviation industry apply some elements of all available frameworks so their portfolio is diversified and organised as well as possible.

3.2.1 Project life cycle

Even though there is very little agreement about the life cycle phases of a project and many organizations have their own internal definitions and templates and this is understandable because of the complicated nature and diversity of projects, which can vary enormously in size and complexity, Newton (2015), in his own way describes a simple four-phase life cycle structure which contains of project initiation, planning, execution and closure, see Fig. 3.1.

Fig. 3.1 Simplification of Newton's Project Life Cycle



Source: Newton, 2015

Nevertheless other authors go in more detail and they also recognize monitoring and controlling as the fifth part of life cycle or name the phases differently. As an example the

Altfeld's (2010) idea can be presented; research, development, production and operation or product support phase. Accordingly, a simple project will involve only a few activities while a more complex project may involve hundreds or thousands of individual activities. The projects performed in aviation industry belong to the second group, their complexity and even the amount of documentation needed are the best prove for it. The mentioned specialist, shows the life cycle as a part of project management integration where systems engineering, life cycle, development, quality management and multi-cultural management are being combined.

As an inseparable element of every project life cycle the stakeholders have to be considered who have varying levels of responsibility and authority. In Silberman's (2000) opinion, stakeholders can have an adverse impact on the project objectives and personal intelligence of a manager can be a huge advantage.

3.2.2 Work Breakdown Structure

Every project can be broken down into some stages and the same rule applies in aviation. A work breakdown structure is a key project deliverable described by Newton (2015) that organizes the team's work into manageable sections.

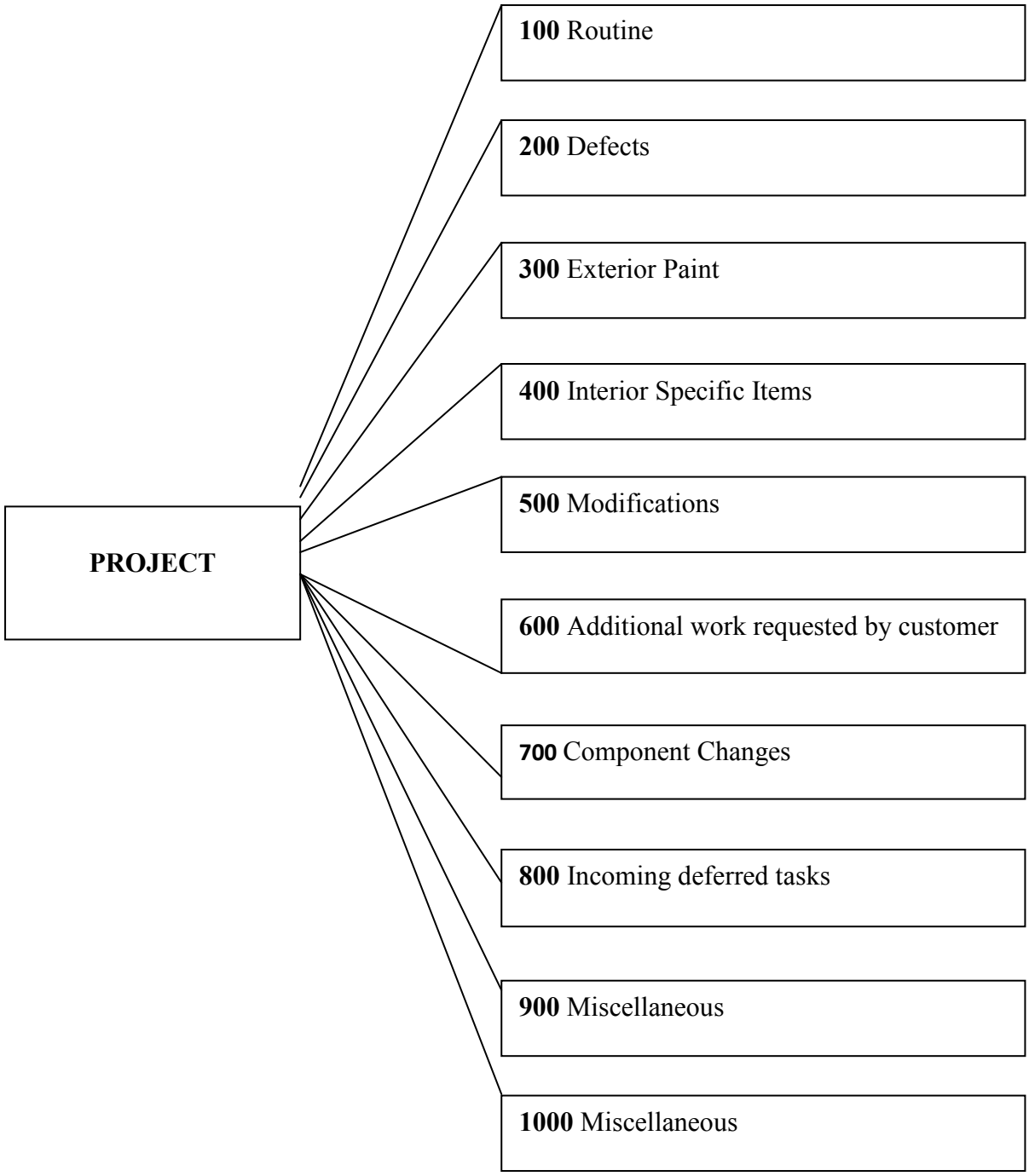
Project Management Institute (2013, p.116) defines WBS as a *"deliverable oriented hierarchical decomposition of the work to be executed by the project team."* Here, in the aerospace, it is strongly visible as there is always a huge amount of rules, laws, agreements and approvals involved which create a need for very accurate and detailed WBS. Every activity can be decomposed. None of the listed stages can be missed as the industry is very strictly monitored indeed - every procedure involves huge costs and documentation.

WBS in LHT is created in the initiation phase. It is necessary to know if the project itself will be profitable or not, all people involved in the project need to know what they can expect and how they need to be prepared also risks have to be factored and predicted – mostly based on previous experiences and some technical data such as age of the A/C, position of the damage, type of /AC, etc. Thanks to WBS top management can decide which facility can handle the project. Main scope of the project has to be created and logistic department together with planners who are responsible for time management need to be informed as well. As costs and quality standards are agreed, the communication must run flawlessly.

When the list of tasks to be performed is created and placed in WBS, each of them is credited with a job card issued by central planning department – group of engineers responsible for a certain project. Each job card fits into the work pack and for each job card certain materials and labour are credited. Most of the time, even though the analysis are performed by experienced specialists, some unexpected events may occur and at this time – they are either agreed as additional work and that is rechargeable or an accidental damage which is the company's lost revenue.

Fig. 3.2 shows so called work packs (WP). Each of the illustrated below groups involves number of tasks and man hours which have to be performed during the A/C maintenance event. The two first groups; 100 – Routine and 200 – Defects, are generally sold to customer as fixed price. Any man hours (MHRS) clocked in excess of what is sold for are usually lost revenue unless a case exists to have them recharged which is very rare indeed. A fixed price is given based for defects which result from various inspections up to a given threshold. It is up to management then to agree with the customer that the MHRS over this are legitimate and obtain agreement from customer to pay which is in the form of Customer Agreement Sheet (CAS). Apart from the two mentioned groups, work pack 600 is also an interesting element. As an additional element, every item included is fully rechargeable within reason being that the customer accepts the figure that we have achieved the work in. It is important to note that there are also groups used and applied which are not mentioned above.

Fig. 3.2 Example of Work Packs structure applied by LTSL



Source: Own elaboration based on observations made in LTSL

Besides the Work Pack breakdown structure, there is also another method applied by LHT in daily milestone plans used for every day project coordination.

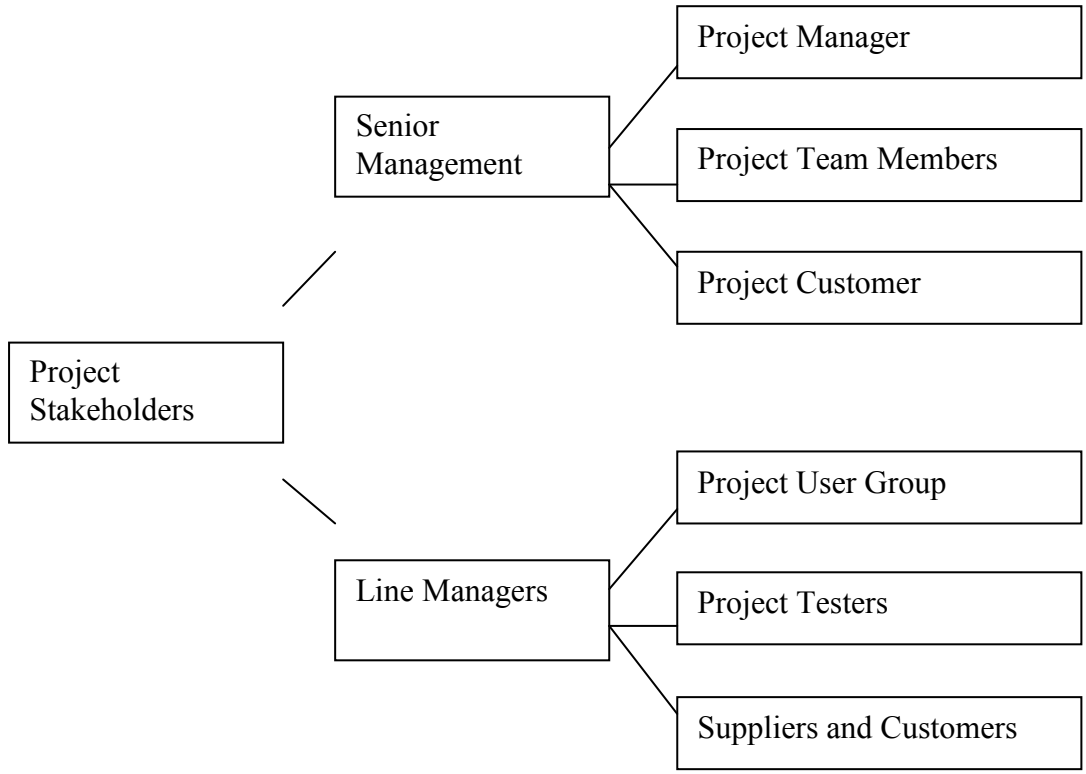
3.2.3 Stakeholders

Not depending on the organization structure, there are certain roles and responsibilities that are required in all projects. Different organizations may use different names for these roles but responsibilities will be more likely the same.

Deducing from Newton's (2015) opinion, stakeholders are anyone who gains or losses from the project and it is a task of project management team to identify them and what is more – determine their requirements and expectations.

Fig. 3.3 gives an example of different parties involved in a projects – starting from senior management and line managers and finishing on customers, suppliers and users.

Fig. 3.3 Simplified division of project stakeholders



Source: Based on Newton, 2015

Involvement of so many different parties within one project is always complicated and often leads to many confusions such as confusions in reporting, recognition of superiors and direct communication with suppliers and customers.

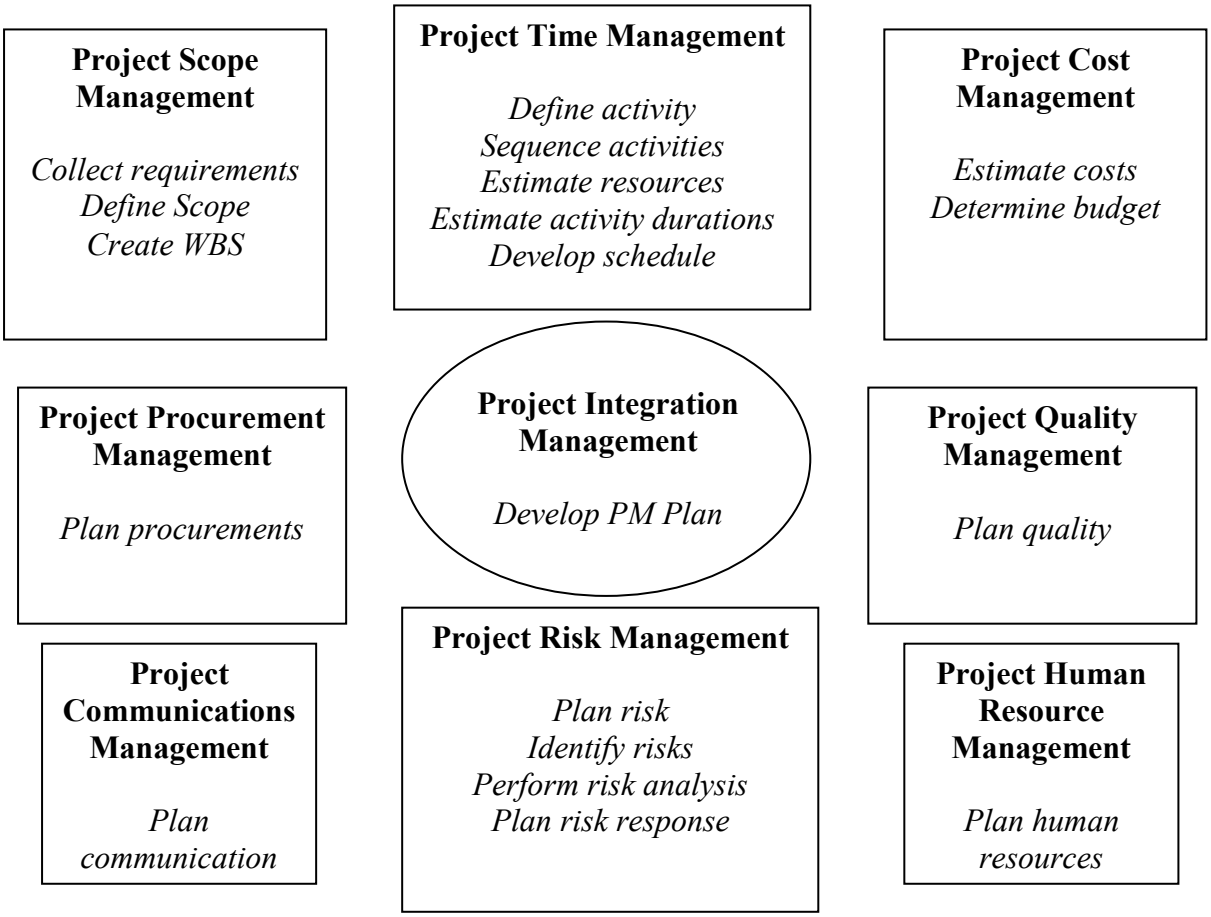
3.3 Theory of project management knowledge areas

Various types of processes associated with the discipline of project management have been classified, evaluated and grouped into nine categories by Project Management Institute, (2013). The understood purpose of these division is to better organize the different processes and bring the processes having common characteristics under one category.

For instance, project cost management would include all the different aspects of the budgeting process. Hence, processes like cost estimating and cost budgeting would fall under this knowledge area. But those 2 processes are not part of the same project management process group. Mentioned knowledge areas categorize and organize processes on the basis of common features, whereas project management process groups are a mechanism to determine the order in which the project management processes should be undertaken.

To make the understanding even easier, the planning process group by Project Management Institute (2013) can be considered, see Fig.3.4.

Fig. 3.4 Simplified Planning Process Group



Source: *PMBOK Guide*, Project Management Institute, 2013 p. 47

It is important to remember here that it is possible to go through those processes more than once while one project.

Successful project managers keep an eye on all project management functional areas such as risk, quality, budget, schedule, scope or team. They gain commitment from outside the project, negotiate necessary resources, decide the best techniques to use, aid decisions for chosen tools or make through assessment at each project phase by Newton (2015).

3.3.1 Project Integration Management

The integration phase in PM *'includes the processes and activities needed to identify, define, unify, and coordinate the various processes and project management activities within the process groups'* (Project Management Institute, 2013, p. 71).

For the integration of a project in LHT are responsible Key Account Managers (KAMs). They oversee the projects. They are to provide a clear direction and support to the stakeholders while keeping everyone focused on the achievement of the objectives. Together with project managers they are responsible for reporting the progress and overall status of the project accurately and in a timely way so any adjustments can be made, if necessary.

It is important to highlight that integration is not only about making decisions for allocating resources but also about solving problems and minor issues before they turn into bigger problems, such as delays or misuse of resources. According to Altfeld (2010), outstanding project integrators have to consider project needs, interdependencies, budgets and their breakdowns, risk analysis, determinations of means of communication, schedule of plans and many others. GANTT charts are presented by the author as classical tools for representation of planned activities and milestones. Within the charts there is also Critical Path Analysis (CPA) applied which is widely presented by Baker (2004).

Lufthansa Technik applies a process-oriented integrated management system where both GANTT ideology and CPA are applied but also adjusted to LHT's needs. *'The process oriented, integrated management system reinforces process safety and increases the employee's competence by providing a transparent and uniform structure of the main business processes, ensures in a systematic manner that all products and operational sequences fulfil the requirements with respect to aviation safety, quality, environmental protection, and occupational health and safety and promotes further development of all*

processes in the interests of customers, partners and employees so that Lufthansa Technik can consolidate its top position in the international market and communicate a positive public image.'(Lufthansa Technik AG Quality Management, 2015, p.42).

3.3.2 Project Scope and Time Management

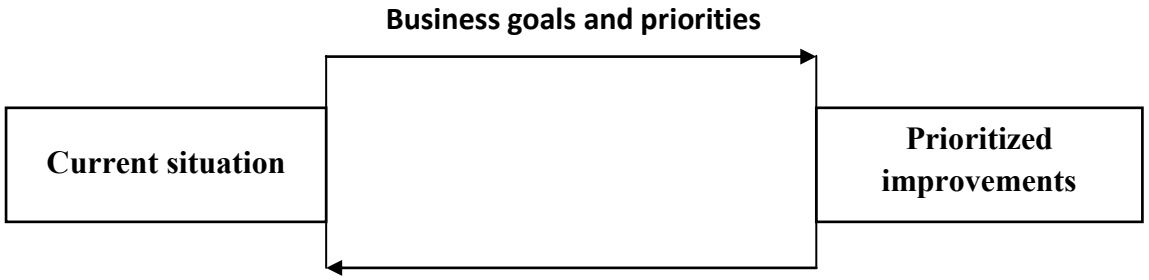
By scope the boundaries of the project are set and it is to ensure the changes to the original scope are carefully managed. It defines exactly what is included in the project and what is excluded. It is to make sure, '*the project includes all the work required, and only the work required to complete the project successfully'*(Project Management Institute 2013, p. 103).

In Aviation, BMS business mostly man hours are sold. Every hour consumed on a project has its value. The value affects the scope of work and time needed to manage the processes directly. Theoretically, it can give a beginning of either a part of the fixed price revenue – amount agreed between customer and company stated in the contract or some additional cost eventually financed by the customer or the company providing with service.

According to Project Management Institute (2013), regular procedures in all industries state that scope of a project consists mainly of collection of requirements such us definitions and documentation from the stakeholders so the company is sure they can properly prepare and meet their needs – this is very important for the planners; scope definition and in more detail development of specific description of the projects – number of tasks to be done, naming of activities, MHRS needed, costs of materials, labour, etc.; creation of WBS which means breaking down all main activities into smaller groups of activities, and then into single, simple manageable components, and this is also performed by planners; verification of scope which basically means a process of formalizing acceptance of the complete project deliverables – as a part of controlling and monitoring – it has to be sure that there are approvals for every undertaken procedure and the documentation and processes were performed according to all instructions, manuals and are accepted by authorities; and eventually scope control which in more detail involves monitoring of the project status , updating the status and managing of all changes in the approved scope baseline, which means describing the trends and making sure all parties are up to date, to make sure it is done, companies create some daily reports with description of milestones.

Fig. 3.5 presents transformation of current situation under constraints such as time, materials, etc. where business goals are set and revised by application of various processes and under constraint of continuous improvements.

Fig. 3.5 Analysis of project scope



Source: Own elaboration based on observation of LTSL management

Even though the scope of work is the main visible element, when people speak about a project success most of the time they base their opinions on either project time or budget. It is a difficult discipline as the time is constantly moving and the project has to be delivered within time according to the approved delivery date.

It is often said the schedule is the biggest source of conflicting during project as it includes the processes required to manage the timely completion of the project. A lot of projects miss their target schedule dates and the misses are often due to changes to the cope or deliverables that directly affect the scheduled completion date.

Processes such as planning and execution are both form of integral part of time management. Time, unlike money, once gone cannot be re-obtained. It is believed time is much more valuable commodity than money. Reducing TAT can lead into opportunity costs and also is a very valuable element of the process. Once sold slot cannot be sold again but the maintenance event planned, can be shorten because of clever production management and this way, the company can earn even more.

The management of time and prioritization of activities depends upon the discretion of the project manager. Fortunately though, there are some standard processes that can help in this regard.

In aviation industry, the use of time management system is recommended and it is a developed combination of tools and techniques that help first planners, second managers and third engineers to identify, analyse, sequence and estimate the duration for all activities related to a project. Project Management Institute (2013) mentions six processes that can help in effective managing of work packages and activities of a project such us *Definition of activities* that involves identification and specification of activities that must be undertaken to produce approved deliverables for a project, *Sequencing of activities* – identification and documentation of relationship between different activities – successor and predecessor activities, *Estimation of activity resources* – estimation of quantities, qualities of material, manpower, machinery or supplies that would be required to perform each activity Estimation of activity durations – estimation of work periods numbers need to complete individual activity with rest no of resources available, *Development of schedule and analyse of activity sequences, durations, resource requirements*, schedule constraints to create a schedule of the project and *Control of schedule* – monitoring of progress, if it is up to date with status, managing the changes to the schedule baseline.

All of the above are performed by LHT's planners, who in the very early phase of each project have to manage timing. Only the last step – control of schedule – is performed by other team members as it is only about monitoring and controlling of progress. The process mentioned above is simple in its idea and very helpful. It is fully applied in daily milestone planning with the usage of mentioned GANTT charts and Critical Path Method (CPM).

Baker (2004) introduced CPM as a technique for doing project planning. As projects consist of number of individual activities it is important to know if they require other activities to finish before some others can start, he compares project to a complex web. In heavy base maintenance, an activity can mean the single Customer Requested Item (CRI) but not necessarily. In some cases many various activities may need to be planned to complete a CRI. For instance, when the inside panels have to be checked, the seats and floors have to be removed as prior. Even though checking the panels themselves takes only 10 MHRS, for getting access there have to be added – 50 MHRS.

To understand the problem more, it is good to point out that there is many ways for estimation of task durations in each project. CPM can only start when there is figured out all the individual activities in the project. Specialists have huge knowledge but also they use similarity to other projects as a factor, they collect historical data, sometimes they use the manufacturer's advice e.g. Boeing or Airbus manuals, some Delphi techniques, which b mean a meeting and discussion between a group of experts, some kind of a three point technique –

where the most optimistic, pessimistic and likely scenarios are taken into account and then an average made. Tasks dependency into account – e.g. removal of floor boards depends on removal of seats first. There is also similar way for estimating the resource requirements; types of resources, facilities, equipment, money and materials, etc.

3.3.3 Project Cost Management

Every project has its commercial part that more than the others is to make sure the company earns profit. It is one of the key measures of good project management. Cost is a big constraint and according to Project Management Institute (2013) understanding, one of the primary focus areas.

One of the project cost management aspect is about estimation, creation of budget, control and approvals. At first, the costs have to be estimated and this is a part of the planning team's job. They count the amount of hours and materials necessary for completion of the plan. Next, the costs for each individual activity are aggregated to work packages. Once the cost baseline is approved, monitoring and controlling takes place. Keeping the project on budget is based on techniques for estimating costs planning and budgeting as well as monitoring and controlling the costs. Some of the materials and services required to complete the project may need to be obtained from outside suppliers. If this is the case then the project manager will also need an understanding of contract and supplier management.

Another aspect can be a supplier's management and it is a big element of the whole cost management program. In BMS there are three common ways of sourcing materials and composites; either customer supplies them – e.g. specific interior elements such as carpets, seat covers; routine materials e.g. or consumables such as oils, greases, etc.; materials usually kept on stock such as filters, screws, etc. or parts available on the open market – sourced by LHT department. It is necessary to mention that all the parts need specific certification; it is either a certificate issued by IASA – Form 1, FAA Form or Certificate Of Conformity. After ordering the components from manufactures e.g. CHEM FAST – chemicals, KLX Aerospace – screws, bolts, etc. each element gets a special batch number – all parts have to be traceable. If the value of them goes under agreed threshold, the customer is not charged additionally. LTSL currently has an agreement for delivering of supplies with Lufthansa Technik Logistics which is a separate company. The delivery timing can be either regular or marked as Aircraft

on Ground mode which means a fast delivery the term was originally used and invented by Swiss Air; AOG means additional costs. In this industry, sometimes time can be more valuable than money.

Also the costs have to be managed when it comes to the production phase, as mentioned above, in every contract there is a defect threshold stated – this is a limit up to which LHT has quoted a total figure based on historical planning data and other information which encompasses large amount of the usual defects found on the a/c. The company is paid for defects in a fixed price up to this limit. All hours over the limit are rechargeable; means the number of direct MHRS utilised per customer requirement item used in the rectification of defects arising from the performance of routine work that is included in the fixed price.

Cost management is also one of the reasons for already described WBS that provides the necessary framework for detailed cost estimating and control along with providing guidance for schedule development and control.

Project costs are also connected with one of Finance and Sales Departments role of setting goals of labour and materials usage which means that to earn the highest profit possible, the production will use less than predicted in the contract according to the man hours needed and materials. Putting it in the other words, the assumption is to earn more than we use, consume less materials than we get paid for and work faster and more efficient than agreed with the customer.

Eventually, it all comes to the final price and financial agreements which are stated in a main contract called Base Maintenance Services, an agreement between the company and customer.

3.3.4 Project Quality Management

Referencing the quality definition by Business Dictionary (www.businessdictionary.com), quality is a measure. It's an element of excellence, a state of being free from defects or significant variations. In aviation, there is no room for deficiencies or defects whatsoever. Everything has to be perfect and certified. In this industry, quality policies are to make sure the objectives, and responsibilities are all applied and performed, so that the project will satisfy the needs for which it was undertaken.

For every A/C there is a list of manuals and documents setting the quality standards. It can be a wiring diagram, structure repair manual, illustrated part catalogues, etc. The lead engineers approve every action and make sure the safety standards are up to date. In aviation, quality means safety and the importance of this one has been described previously.

In day to day LTSL's managements, quality is one of the KPIs measured on a daily basis together with factors such as safety, delivery, cost and people.

3.3.5 Project Human Resources, Communications and Risks Management

From Kemp (2006), can be deducted that projects are simple delivered by sets of individuals, in other words project teams and those often include people who are critical to deliver the project. Project members can be classified as individuals with some value to the project, individuals who posses necessary skills required to deliver the project and individuals who are decision makers. A successful team should definitely consist of highly skilled members. But not only skills can make a team effective. Member satisfaction, member development, flexibility, coordination, cooperation and productivity are elements without which a team could never achieve any goals. LHT invests in people. Various cultural training when moving from one location to another are held, Lufthansa Business School is conducted to enable employees to develop their skills and knowledge, and of course technical continuous training for professionals – aviation mechanics and engineers.

Communicating, exchange of information between two or more parties can be described by many communication models, but all of them assume importance of identification of stakeholders, planning the communication, distribution of information, management of stakeholder's expectations and reporting of performance.

Same in business and life, communication is a skill that is constantly developed. According to Silberman (2000), project managers most of the time are people with excellent communication skills and highly developed interpersonal intelligence. The author actually mentions many ways how to improve interpersonal skills and improve some of the assertive techniques. There is always room for improvements, especially in this matter. .

In LTSL, communication within teams begins at a Kick-off meeting where Key Account Manager introduces a new project to his team, it is continued at daily project meetings – data presented at the meetings is also described at the production boards as above,

status meetings, project status reports and finally at wash-up meeting after completion of a project.

Communication is strongly connected with risk, which is defined by Project Management Institute (2013) as lack of knowledge about possible future events that may either bring positive or negative impact. In Aviation, surprises are definitely not desirable. The whole planning process, constant control, meetings and monitoring progress are all to avoid risks and uncertainties. Even though risks are undesirable, good project managers have to be constantly aware of risks. They take care of planning risk management, their job is to identify risks, perform some risk analysis, analyse risk in numerical terms, plan risk response scenarios or monitor and control risks. It includes the processes of conducting risk management planning, identification, analysis, response planning, and controlling risk on a project.

Altfeld (2010) introduced a multi-functional teams which are to ensure making right decisions in a timely manner and at the right level. The mentioned groups are on organizational challenge but are a huge advantage – in LTSL this model can also be observed. The teams are capable of working independently, as they often consist of specialists from every field. The multifunctional teams are perfect for well communication assurance and avoidance of risks. Such successful team members know exactly the criteria of their work and they are adequately empowered.

4 Evaluation of a particular project

This practical and methodological chapter is based on evaluation and appraisal of a project example performed by Lufthansa Technik. Information presented in this chapter is not exact and varies from the reality. All numbers and characteristics are created for better viewing of the project and are based on assumptions. The data is to introduce the complex project's specifics. Project taken into evaluation is highly simplified and adjusted to the needs of the author of thesis.

Theory gives a base to development of all practical solutions. In modern companies such as Lufthansa Technik Shannon Limited project management is applied in every phase of service or product distribution and running of the facility. The areas described are necessary for successful management and leadership in business. Complexity of aerospace industry demands highly advanced solutions and techniques for overseeing of targets, engineering or planning of new events.

Evaluation in other words means importance, effectiveness of processes or a diagnosis. According to this criteria, one of the projects previously performed by LTSL is considered. An aim of this idea is to show the specifics of application of typical project management areas and uniqueness connected with the industrial specifics. The evaluation is based first on assessment of project management areas used in certain phases of a project life cycle, the main outcomes of a project – if it was overall successful or not, fulfilment of company goals, emphasis on complex areas and areas of difficulties and some possibilities where continuous improvement could be implemented.

Before the project evaluation, it is sufficient to describe the main idea, goals, characteristics and parties involved.

As described in the theoretical part, LHT is an example of MRO provider. Lufthansa Technik Shannon Limitied in the past performed maintenance for a very big airline – Customer X. The event consisted of repairs for a number of aircraft – for the needs of the projects a number eleven aircrafts is taken into account. The events were based on the typical, routine controls of airplanes motivated by EASA, manufacture's standards and specific CRIs, Maintenance Planning Documents, Airworthiness Directives, Service Bulletins, Specific Customer Tasks or Engineering Orders. The main goal of Customer X was to make sure the aircrafts stay airworthy and LTSL's goal was to gain a long term positive relationship with

the customer, provide with MRO in timely manner, earn profit by performing the maintenance.

The events were performed on a basis of 6-year checks from the group of technically called IL which contains all 6-year or 24000 flight-hour MPD demands which are described in deep detail by Airbus specialists (*www.airbus.com*). Based on the agreement with Customer X, LTSL had 19 days for every single aircraft which is a standard time period offered by MROs in the industry in case of IL-checks.

4.1 Initiation phase

Starting up a new project, so called initiation phase, is probably the most crucial phase of every new event. In this phase, important is to define scope and purpose and assign a group of specialist – team members, to a new tasks. Only when the scope is clear and the team prepared, the manager can be assured of the success.

Request For Quotation sent from customer to interested MRO gives a typical start of a new project business case in Lufthansa Technik. After presenting the work scope and negotiation with sales department, LHT have the agreement contracted and according to Six to One pattern, the company's top management decides which facility the A/C or a full series of checks best suits. To make the choice, network management of LHT considers 29 bays in the network. Production management representatives of every facility are asked during daily Top Plus Meeting if they are able to accommodate the check in their slot schedule – according to the predicted MHRS and if the resources they have are enough to fulfill the customer's requirements in the timely manner. According to the procedures, LTSL was able to accommodate the IL-6 year-checks of 11 Airbus Family aircrafts and prepare the release under EASA quality standards. Projects stakeholders assigned to the project were KAM, technical representatives, project manager, materials coordinator, onsite planners, lead engineers for each work station, and supporting teams from stores, facilities, CAMO.

Even though the initiation phase is only a beginning, it combines all project management knowledge areas – integration management is needed for combination of customers requirements, scope and time management are performed by the central planning while creating of the work packages. Cost management is a base, as the company and the customers at the very beginning of negotiations have to calculate their possibilities and make sure the financing sources and revenues or expenditures are acceptable. Even though the

quality management is not visible directly, it is actually big motivator as the Customer Requested Items are strictly bounded with MPDs and other important documents which reflect law and what is more, law reflects safety rules and is controlled by the authorities responsible for industry.

Importance of all described processes ought to be highlighted but one of them, placement of the project or series of projects in the facility slot schedule demands a further explanation as it is a huge logistic venture and is strongly connected with risk and risk mitigation.

Slot schedule, a live document which is adjusted to the real situation on a daily basis is a base of LTSL operations. It presents the projects which are currently performed, were recently accomplished or will be carried out in the future, it shows current status and duration. Focusing the evaluation on time and scope management, it is not allowed not to mentioned the slot schedule as it is probably the most important tool and a report of managers working on LTSL's success. It gives a view of the facility's capacity – in LTSL example – there are six bays where six aircrafts can be accommodated. In this part of considerations, it is only sufficient to indicate, the slot schedule is a mean for either opportunity loss or profit. And the assumption A) is made on a basis of planning the risk – on one hand it can be assumed that every maintenance event goes according to plan and there is no need for any time buffers and on the other hand, there can be planned buffers accommodated – assumption B). As described by Altfeld (2010), in aviation risk mitigation is even more important than in every other industry as aviation is a place of extreme and rapid development of projects; overlapping and concurrent ways of working are applied. What is more, quick decisions have to be made fast and most of the time, the decision makers are lacking in information – there are many unknown which cannot be predicted in the initial project phase such as amount of additional work, unexpected findings on an aircraft, special customer demands which were not indicated at the start, future problem with either customer supplied or LTSL supplied materials and many others.

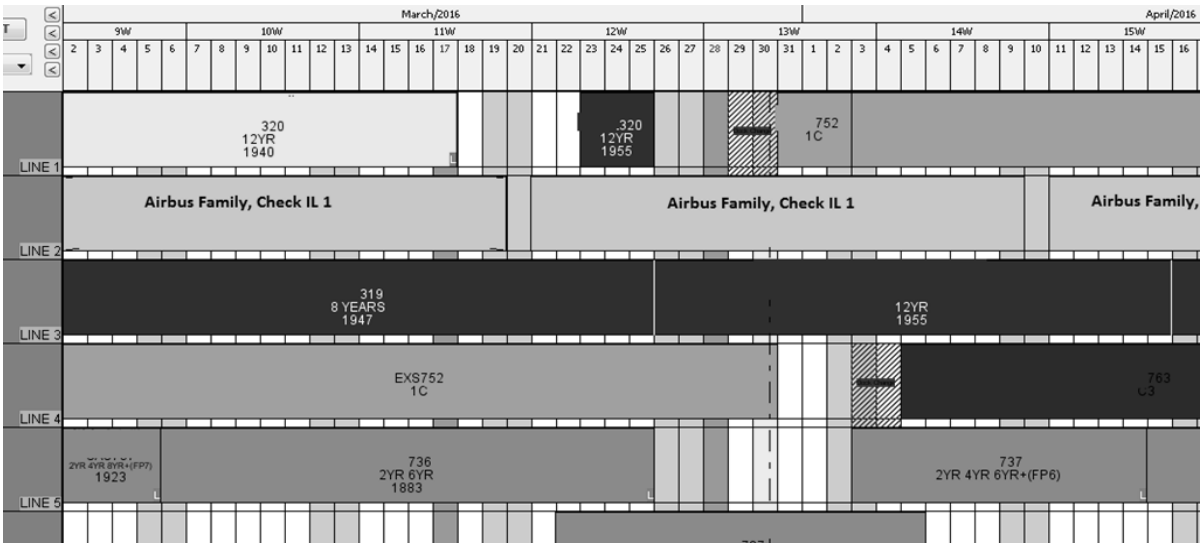
Risk Management is about anticipating and mitigating adverse impacts which will occur with a less certain probability (Altfeld, 2010, p.195). Using the authors ideology and according to assumption A), there is a very high risk in case of a late redelivery of an aircraft after maintenance. In this business, it is typical some parts are delayed as they are shipped from very distant places in the world, it is also possible the customer delays the program or there are many technical findings on an aircraft which prolong the event and it is not possible finish in the planned time period. The delay, can cause in a loss of the next customer's trust –

LTSL has no hangar space, the new customer is waiting, AOG can cause high costs which have to be covered by the customer. On the contrary, according to assumption B), when the buffers are applied, in case of a delay, the company can use the buffer as a time for unplanned or prolonged actions and take the next customer as planned without any schedule changes. On the other hand, if the check goes according to schedule, there is an opportunity waste because the hangar space is empty and the possibility of creating MHRS and in result, revenues is lost.

Both mentioned variants carry different types of risks which can be estimated only on the base of historical experience of the company and work scopes but sometimes this part can be very uncertain as LTSL cannot predict the total amount of additional work that may arise.

In the case of series of the eleven IL-checks which in the slot were meant to follow each other, after risk estimates, LHT decided to implement a one-day buffer solution which is presented in Fig. 4.1 above. In LTSL the one day buffer is quite often applied. In practice, the problem is even more complex when the following projects are represented by different customers. Sometimes network management plans even longer buffers as presented on Fig. 4.1 on Line 5 there is an eight-day buffer applied which was probably planned along with the very high risk of major delays of either aircraft future arrival or expected delays of customer supplied materials.

Fig. 4.1 Simplified illustrative example of slot schedule



Source: Own elaboration based on materials by LTSL, 2016

Even though the buffers are applied and they are to reduce risk, it is still sufficient to monitor the ongoing projects and make sure risk monitoring is being constantly performed. The mentioned action in practice comes with time and is an element of the next project phases.

4.2 Planning

To successfully plan the project in other words, necessary is creation of some kind of a guide that will lead the production through the project execution phases. All outcomes of this phase are to guide production in management of time, cost, resources, quality and the others. Planning in aviation is definitely very demanding because it often means guessing from a huge number of unknowns.

After the facility acceptance and input on the slot schedule, the check is planned by a central planning department, based in Sofia, Bulgaria, and the results transformed to the performing facility. The results are summarized in a planning package for a handover to production. The mentioned package consists of part work packs which represent certain actions, MHRS, costs of MHRS produced, rates and facility targets which can also be transferred into monetary values of revenue and this is the financial plan for the company. Work packs are extremely important from the commercial point of view as they depict a value which can sometimes be overrated in the contract signed which in practice means that if the real amount of work is bigger than the work pack value, the customer is obliged to bear additional costs but it does not mean a direct revenue for the company as it can also be considered as a risk because the additional work can cause additional MHRS input, delays in the projects which can even affect the whole slot schedule for LTSL.

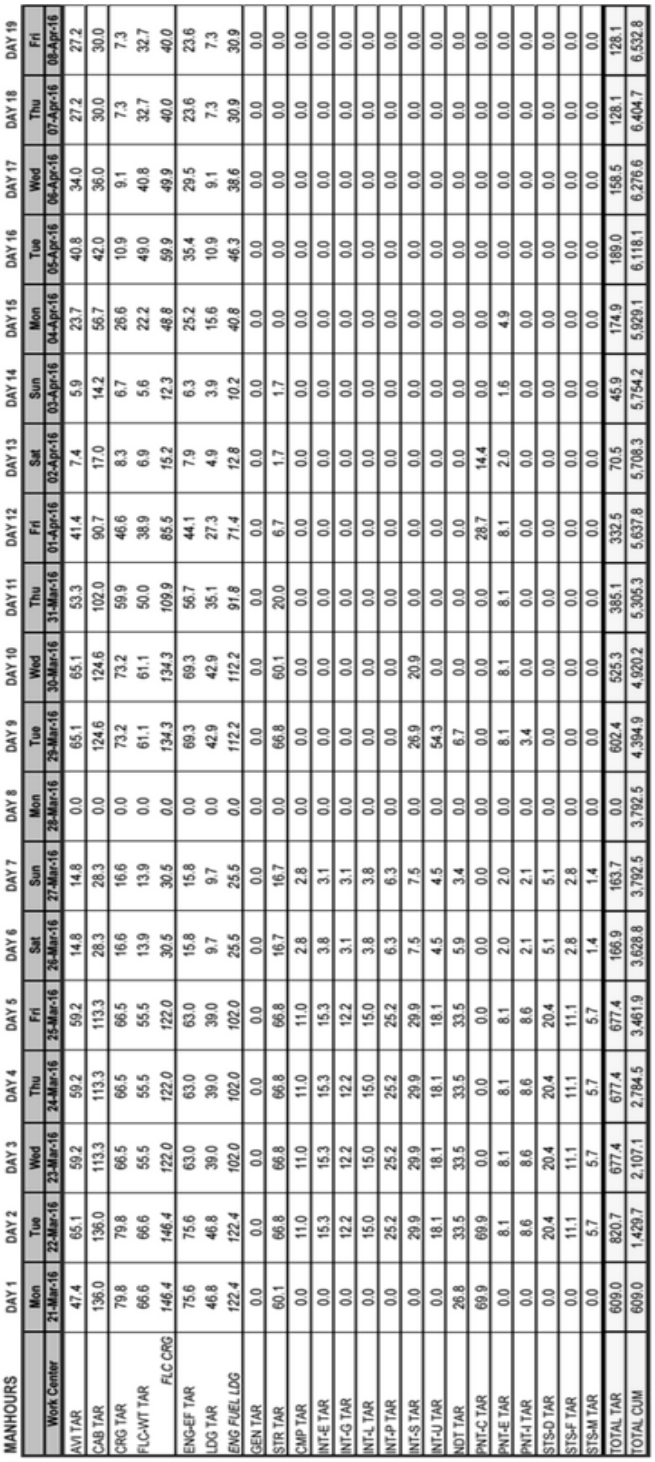
Using the received data, local planners identify the exact capacity requirements and prepare a breakdown of man hours for every work station to ensure the right scope and time management. The planners have to take into account access, type of work, risks and others and also identify needed materials and required tooling. Knowledge of milestones and task dependency are fundamental. This is the moment when CPM is applied. The mentioned planners are aviation engineers, they technically know the work very well and on the other hand they are to ensure the technical and administrative direction is applied. Also surveillance to document the physical characteristics is necessary and has to be scheduled.

There are many ways used for estimation of task durations in each project: similarity to other activities, historical data, expert advice, derivative of most optimistic, most pessimistic and most likely estimate which in consequence after using the quantitative methods by Brandimarte (2011) make an average. Also according to the Critical Path Method standards, it is inseparable part of every task dependent events to find successors of every activity so the process can run flawlessly.

In LTSL, planners use mentioned Critical Path Method, GANTT charts and Excel sheets to present their work outcomes such as adjustment of MHRS into work packages and work stations. As an example, see Fig. 4.2 with presented distribution of targets assigned to each day and every work station possible. The two elements of function are so called Work Center e.g. Avionics Target (AVI TAR) and duration of a project in days. For every Work Center, there is an accurate numbers of working hours assigned for each day. Thanks to this summary, the production managers during execution will know exactly how many team members they need for every day and after daily calculation of MHRS used, can be easily accessed if the project in on schedule or not, if the quality of MHRS is correct or not, of the materials supply is accurate or if the financial plan is being fulfilled.

Another example of a quantitative element application is visible on Fig. 4.3 and is an example of a direct application of the targets created and applied in Fig. 4.2. Once the plan is done, and number of hours for every Work Center known, the values can be transferred into actions and milestones of project. As per CPM, there has to be a critical path, a sequence in every projects. Corresponding to Fig. 4.3 Power On (PWR ON) task can only be performed after completion of critical inspections (Critical ISP Completed) and if the task is delayed, the whole projects is delayed as well because the successors cannot be performed. As an example, when the special material or equipment crucial for the inspections is late, because of the suppliers' mistakes, the whole project is delayed – even though the company is able to provide with every other tool necessary for every other element of check.

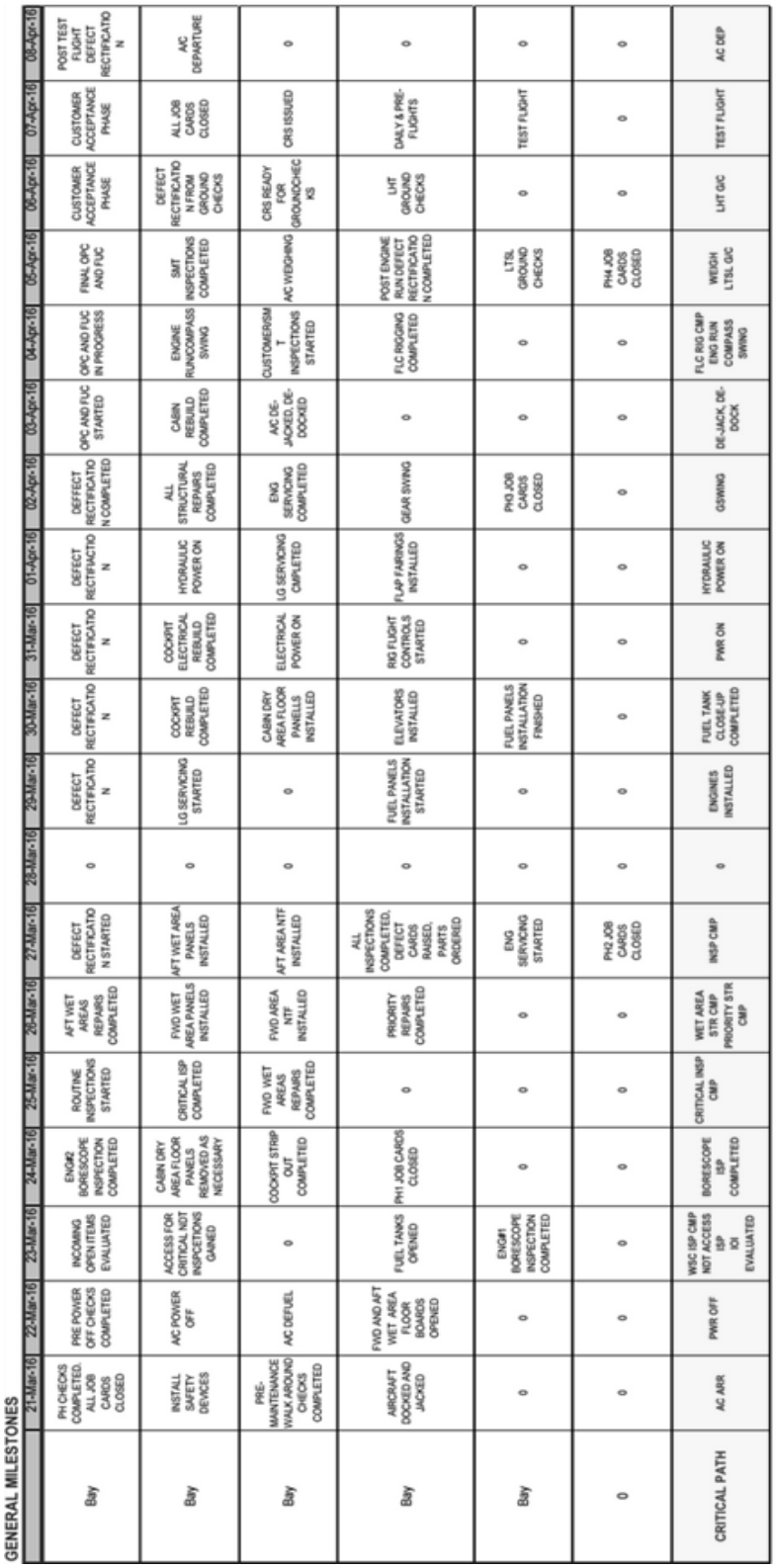
Fig. 4.2 Distribution targets of MHRS by day and by work station, IL-check for Airbus A/C



MANHOURS	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	DAY 8	DAY 9	DAY 10	DAY 11	DAY 12	DAY 13	DAY 14	DAY 15	DAY 16	DAY 17	DAY 18	DAY 19
Work Center	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri
	21-Mar-16	22-Mar-16	23-Mar-16	24-Mar-16	25-Mar-16	26-Mar-16	27-Mar-16	28-Mar-16	29-Mar-16	30-Mar-16	31-Mar-16	01-Apr-16	02-Apr-16	03-Apr-16	04-Apr-16	05-Apr-16	06-Apr-16	07-Apr-16	08-Apr-16
AVI TAR	47.4	65.1	59.2	59.2	59.2	14.8	14.8	0.0	65.1	65.1	53.3	41.4	7.4	5.9	23.7	40.8	34.0	27.2	27.2
CAB TAR	136.0	136.0	113.3	113.3	113.3	28.3	28.3	0.0	124.6	124.6	102.0	90.7	17.0	14.2	56.7	42.0	36.0	30.0	30.0
CRG TAR	79.8	79.8	66.5	66.5	66.5	16.6	16.6	0.0	73.2	73.2	59.9	46.6	8.3	6.7	26.6	10.9	9.1	7.3	7.3
FLC-WT TAR	66.6	66.6	55.5	55.5	55.5	13.9	13.9	0.0	61.1	61.1	50.0	38.9	6.9	5.6	22.2	49.0	40.8	32.7	32.7
FLC CRG	*146.4*	*146.4*	*122.0*	*122.0*	*122.0*	*30.5*	*30.5*	*0.0*	*134.3*	*134.3*	*109.9*	*85.5*	*15.2*	*12.3*	*48.8*	*59.9*	*49.9*	*40.0*	*40.0*
ENG-EF TAR	75.6	75.6	63.0	63.0	63.0	15.8	15.8	0.0	69.3	69.3	56.7	44.1	7.9	6.3	25.2	35.4	29.5	23.6	23.6
LDG TAR	46.8	46.8	39.0	39.0	39.0	9.7	9.7	0.0	42.9	42.9	35.1	27.3	4.9	3.9	15.6	10.9	9.1	7.3	7.3
ENG FUEL LDG	*122.4*	*122.4*	*102.0*	*102.0*	*102.0*	*25.5*	*25.5*	*0.0*	*112.2*	*112.2*	*91.8*	*71.4*	*12.8*	*10.2*	*40.8*	*46.3*	*38.6*	*30.9*	*30.9*
GEN TAR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STR TAR	60.1	66.8	66.8	66.8	66.8	16.7	16.7	0.0	66.8	60.1	20.0	6.7	1.7	1.7	0.0	0.0	0.0	0.0	0.0
CMP TAR	0.0	11.0	11.0	11.0	11.0	2.8	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INT-E TAR	0.0	15.3	15.3	15.3	15.3	3.8	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INT-G TAR	0.0	12.2	12.2	12.2	12.2	3.1	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INT-L TAR	0.0	15.0	15.0	15.0	15.0	3.8	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INT-P TAR	0.0	25.2	25.2	25.2	25.2	6.3	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INT-S TAR	0.0	29.9	29.9	29.9	29.9	7.5	7.5	0.0	26.9	20.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INT-U TAR	0.0	18.1	18.1	18.1	18.1	4.5	4.5	0.0	54.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NDT TAR	26.8	33.5	33.5	33.5	33.5	5.9	3.4	0.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PNT-C TAR	69.9	69.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.7	14.4	0.0	0.0	0.0	0.0	0.0	0.0
PNT-E TAR	0.0	8.1	8.1	8.1	8.1	2.0	2.0	0.0	8.1	8.1	8.1	8.1	2.0	1.6	4.9	0.0	0.0	0.0	0.0
PNT-I TAR	0.0	8.6	8.6	8.6	8.6	2.1	2.1	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STS-D TAR	0.0	20.4	20.4	20.4	20.4	5.1	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STS-F TAR	0.0	11.1	11.1	11.1	11.1	2.8	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STS-M TAR	0.0	5.7	5.7	5.7	5.7	1.4	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL TAR	609.0	820.7	677.4	677.4	677.4	166.9	163.7	0.0	602.4	525.3	385.1	332.5	70.5	45.9	174.9	189.0	158.5	128.1	128.1
TOTAL CUM	609.0	1,429.7	2,107.1	2,784.5	3,461.9	3,628.8	3,792.5	3,792.5	4,394.9	4,920.2	5,305.3	5,637.8	5,708.3	5,754.2	5,929.1	6,118.1	6,276.6	6,404.7	6,532.8

Source: Own elaboration based on observation of Local Planning Department's documentation in LTSL, 2016

Fig. 4.3 Application of CPM in general daily milestones planning, IL-check for Airbus A/C



Source: Own elaboration based on observation of Local Planning Department's documentation in LTSL, 2016

Planning phase turns out to be a complex element where integration management allows to combine the customer's needs with facility's capabilities, where scope and time management are created and prepared for execution, quality management actions are also adjusted and organized – sometimes needs of audits can be announced. But planning on the other hand is only a preparation. Balancing in the number of unknown. It gives a direction and beginning to the next phase of execution, where production have to face the management of human resources, communication with all departments and risk in the form of time and scope assessment under various constraints.

4.3 Execution

The third phase in life cycle is for the team to finally build a project physically and for the managers to present it to the customers for a sign off. It consists of management of time, scope, quality, change and risks, acceptance, communications and a final review.

In LTSL, execution phase starts by a Kick-off meeting which takes place from four to seven days from the project's start date. Assigned Key Account Manager meets the team, introduces them to main goals, objectives and the most characteristics elements of the project. Kick-off is to highlight the important factors and to make sure that the relevant either commercial and technical factors are known while production. Once the aircraft arrives, the process has to run flawlessly. As the targets were set and presented on the Daily Milestone Plan, during the execution the processes have to be constantly measured and controlled by the Key Performance Indicators.

Project communication management in the phase of planning comes in force as the importance of quick actions and risk mitigations appears. In case of negative events, the affected stakeholders have to be identified almost immediately and corrective actions applied.

In LTSL, the typical way on a daily basis is to monitor safety – if any accidents occurred, if yes what kind and why, quality – control tool which allows to find out if there are any mistakes made, delivery – amount of job cards closed or in other words, fulfillment of milestones, cost – amount of materials used and MHRS created against the actual targets, people – factor which allows to assume if the company has enough people to operate which is shortly described as Required to Operate (RTO).

There are also measured KPIs such as productivity – expressed in MHRS generated by individuals and teams per day, resource utilization – indicator which shows if the staff is utilised on productive work and milestones achieved.

Project risk management is faced in the execution phase of a project as well. Risks can be caused by not enough number of staff – e.g. mechanics available to perform certain jobs, not enough of certified staff, problems with availability of materials or deliveries, unusual findings or very high number of findings.

The customer in Lufthansa Technik is put on the first place and therefore the communications is extremely important. There are certain meetings and reports run every day so that the customer has always access to current project phase and daily status – an example of the report can be Fig. 4.3, customer has access to the document and is informed on an ongoing base in case of any changes in the program.

Execution is a challenge and especially in aviation, it is time when the greatest amount of work has to be performed. During this phase, it turns out how good the planning was. Especially for this reason, there is always a Wash-up meeting called after every project. LTSL applies improvements after every project closure so the new ones, can be even more faultless. During the meeting, the production on managerial specialist highlight the most difficult areas. On this particular Wash-up must have been highlighted that there was a minor problem with the customer-supported supplies, according to late delivery of parts, two out of eleven projects were delayed. Probably, there was also some solutions applied on how to avoid similar problems in the future. But understanding the industry, it is know the changes in suppliers are extremely difficult and it is a huge challenge for any company to improve in this area.

4.4 Closure phase and summary of project evaluation

In aerospace not only customer's acceptance can mean the project's closure. According to law, a recognised authority has to grant an aircraft or project release for instance EASA and a person who can sign off documentation grants the Certificate of Release to Service (CRS).

Every project closure demands a summary and for this reason, a wash up meeting is planned after every finished event.

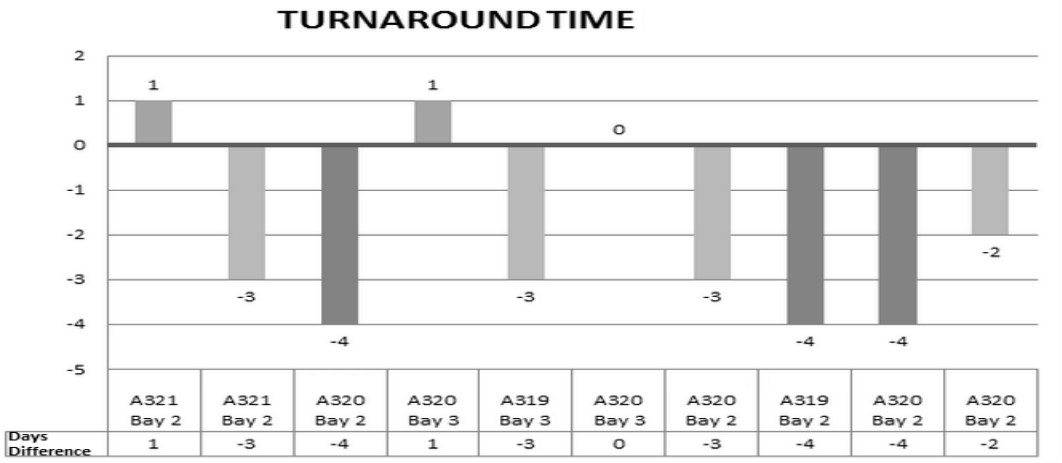
Closure phase means something different for every stakeholder and for example a Key Account Manager can be taken into account who is responsible for making sure the commercial project release is granted and the financial documentation properly organized. Most of the projects demand some kind of a recharge – as already presented – there are many kinds of risk and it is impossible to totally predict the amount of work on an aircraft. When the basic contract is signed and a general costs evaluated, there is also a need of preparation of additional documentation, in LHT there are Customer Approval Sheets which include every recharge either in labour or monetary value that has to be paid by the customer additionally.

There are always problems that have to be faced and dealt with. In case of the described IL-checks for instance, there could have been problems with sourcing of rare materials which in the future can be avoided by change of the suppliers or improvement of communication between the LTSL material coordinators and the suppliers. The mentioned problem with both communication and responsible stakeholders identification and furthermore with planning and applying of the corrective action, two checks in the contracted series were delayed by one day. Sometimes a minute of delay can cause 24hour retardement especially in aviation where MRO relies on opinion of Airbus or Boeing as the key oriented authorities in the technical, engineering phase or on suppliers which organize shipments of valuable materials by huge distances.

Even though there was some minor inconveniences, the whole project series contracted by the customer X turned out to be a huge success – the overall redelivery after 11 aircrafts turned out to be even earlier than planned and TAT shorter. The opportunity costs connected with AOG to be beard by the customer were lower than predicted and the contracting party created a long term good relationship with LTSL.

Even though the program was overall a success, there are some highlights for the Central Planning Department and local planners to be considered. Fig. 4.4 presents a chart with turnaround time of every project that was performed according to the contract between LTSL and customer X.

Fig. 4.4 TAT summary after completion of the whole contract for Customer X



Source: Own elaboration based on observation of Local Planning Department's documentation in LTSL, 2016

Three of the events let LTSL safe 4 days of hangar space and availability of resources to perform different actions which can lead to revenue increase, three events let to safe three days, one event allowed for saving of two days and one project was delivered just in time. Because of the mentioned problems with materials and incorrectly estimated time needed to perform some duties, LTSL had to prolong two checks and therefore noted a loss of two days – because there were the buffers planned, the overall slot schedule was not affected at any time.

4.5 Summary of project evaluation

Summarizing, LTSL was able to finish the contract twenty one days before planned closure date and this let to accommodate one more aircraft for another IL nineteen days long check and also allowed for a light three day check planned and accommodated by mini business department. In other words, smooth project coordination by the experienced staff allowed to save time and generated higher than planned revenue.

During the project, company had to face problems such as accommodation of the check in the slot schedule, involved in planning of milestones, highly interlinked activities and managing of high complexity of interdependencies between sets of skills and various iterative

steps where the final outcome cannot be exactly known in the beginning caused by high volume on unknown, rapid development and communication.

Comparison of the initial goals and overall success in the end allows to think LTSL fulfilled their mission. The customer was very satisfied as the project was completed before agreed time, LHT turned out to be a great choice in the area of MRO distribution.

The initiation phase, start of the project turned out to be challenging, as a very close cooperation between network management and local management was crucial. Also risk mitigation had to be understood and applied. The decisions were made by specialist on the base of historical data and planning coordinators. The number of days taken into considerations turned out to be sufficient and even too long. The safe calculation was to avoid problems with delays in case of some unexpected situations during execution phase. In the future, the company could consider accommodating the IL checks for Airbus in shorter time intervals and periods, instead of nineteen days, there could be a plan for eighteen days created. Also excluding buffers from the slot schedule could be considered.

Phase of planning was mainly challenging for the planners themselves and management. The professionals were responsible for creation of a guide for the production. In case of wrong calculations and milestone plans, problems with fulfilling of tasks and goals could occur. LTSL specialists successfully applied CPM which helped to maintain correct interface with the customers while execution. The interested parties had easy access of the project steps track. Even though, two of the project from the series were delayed by one day, the customers were kept informed and there was no negative feedback. Nevertheless, the production and management from LHT should still determine the exact source of problems and address is to the particular stakeholders so they can be avoided in the next planning events.

During execution of the project, after-effects of the organization of event and good work of the planners' were visible. Even though, the planning was correct – the mentioned number of unknowns lead to some minor problems. It turned out there are still some areas for improvement such as supplies and communication which should be definitely considered by the management. Generating of a new product is definitely more difficult that working on the same one a couple of times and maybe this helped but on the other hand, the turnaround time in following aircraft check were not a function which means that the problems occurred were extraordinary and definitely not connected with regular management and process run. Maybe the company should invest in some extraordinary or emergency solutions, emergency planning to avoid problems.

The project closure phase was a definite success of the company where the professionalism was highlighted and areas for improvements determined. Because the company was not prepared for an early finished, the free hangar space was not used. This shows a need for development of quick actions in case of any free bays in the network. Even a few hours of free hangar space, together with availability of resources, could allow to create higher revenue which lead towards huge advantage of the mini business options. The company could probably decide to evaluate some advantages of having some kind of 'emergency' customers who would be able to bring in their aircraft very fast, for a small check. This way both parties could gain profit – LTSL, time – customer.

5 Conclusion

Development of project management discipline was definitely beneficial for the industry and stopped performing of projects that were not profitable and lead to waste of time and resources. This basic but crucial fact presents exactly what good project management is about. All the project management areas mentioned and described are to ensure the projects are finished with a financial success in the agreed time manner.

Described in the second chapter business model, Lufthansa Technik is a giant MRO provider known worldwide. LTSL can be summarized as a competitive firm with continuous growth, highly flexible and LHT as a group which offers 30 subsidiaries and 26.000 employees worldwide. In the effect, management of such a huge corporation is extremely complex and managers have to face various unforeseen difficulties. As already highlighted, it is management of unknowns that lead to either success or failure. To enable correct problem analysis and personnel development, LHT should consider some risk analysis courses that would allow the employees for understanding of risk awareness and risk mitigation on a high level. This way, the company could become even more competitive and grow faster.

Presented in chapter three different managerial techniques and aspects are widely applied, but the most equivalent to aeronautical environment are fields such as management of time and scope, integration of the project, planning of human resources, materials, risk mitigation, communications and ability to adapt to changes. It turns out, that extreme lead times, high rate of fast risk development, make the cost of mistakes in aviation even bigger and therefore simple mistakes are not to be made. To avoid the problematic issues, company applies complicated means such as CPM, WBS and WP – in case of financial field.

Presented in chapter four, simplified example of a check performed by LTSL shows how organized a process needs to be, how important the project nature really is, and if there are any problems at all, they are unusual and do not belong to any kind of problematic function. The allowed difficulties are only the ones that are unpredicted. Based on historical and aeronautical knowledge engineers and planners are trained in avoiding of constraints and always the basic problems are meant to be predicted and avoided. There are still some recommendations for the company, such as investing in small business solutions to accommodate some extra resources and hangar space available, investigation of problems with communication and suppliers or changes in risk mitigation and planning of unknowns which would allow to safe some time during the production – execution phase.

The general outcome after presented example – saving of so many hours of slot availability – if intelligently planned and used, can be a huge advantage of the company and lead to even more recognised growth and improving of relations with customers. It is also definitely a huge advantage in the light of high industry competitiveness and the competitor's development. Integration of engineering with management could also give a chance for big customers' and suppliers' involvement moreover, it could improve the company's image.

Having the possibility of observation of processes by the mentioned MRO, it is clear why Lufthansa Group has been on the market for so long and why the firm is still growing and developing. The professionals employed are Lufthansa's key to success. Project management knowledge areas are applied by the specialists who know exactly in which way they should be adjusted. The specialists understand the importance of risk mitigation, wise resource planning and communication.

In the changing world, it is difficult to predict the future. Project management in LHT will definitely grow and transform together with technology or communication transformation. The main goals though will always stay the same. Project organization will always aim to succeed and develop.

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List of Abbreviations

A/C	Aircraft
AD	Airworthiness Directive
AOG	Aircraft on Ground
AVI	Avionics
BMS	Base Maintenance Services
CAB	Cabin
CAMO	Continuous Airworthiness Maintenance Organization
CAS	Customer Agreement Sheet
CEO	Chief Executive Officer
CLE	Cleaning
CMP	Composites
COC	Certificate of Conformity
CPA	Critical Path Analysis
CPM	Critical Path Method
CRG	Cargo
CRI	Customer Requested Item
CRS	Certificate of Release to Service
DLH	Deutsche Lufthansa
EASA	European Aviation Safety Agency
EBT	Earnings Before Tax
EO	Engineering Order
EOL	End of Lease
ENG	Engine
FAA	Federal Aviation Administration
FLC	Flight Controls
H&S	Health and Safety
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IL-check	Intermediate Layover Check
INT	Interiors
IPPC	Intergovernmental Panel on Climate Change
ISO	International Standardization Organization

KAM	Key Account Manager
KPI	Key Performance Indicator
LAE	Licensed Aircraft Engineer
LDG	Landing Gear
LHT	Lufthansa Technik
LTSL	Lufthansa Technik Shannon Limited
MHRS	Man Hours
MPD	Maintenance Planning Document
MRO	Maintenance Repairs Overhaul
MTC	Maintenance
NDT	Non Destroyable Testing
OEM	Office of Engineering Management
PERT	Program Evaluation and Review Technique
PIR	Post Implementation Review
PM	Project Management
PMBOK	Project Management Body of Knowledge
PNT	Paint
PRINCE	Project in a Controlled Environment
RFQ	Request for Quotation
RTO	Required to Operate
SB	Service Bulletin
SCT	Specific Customer Task
SO	Sales Order
STS	Structural Shops
STR	Structures
TAR	Target
TAT	Turnaround Time
TTS	Total Technical Support
QCDMS	Quality, Cost, Delivery, Morale, Safety
WBS	Work Breakdown Structure

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Declaration of Utilisation of Results from a Bachelor Thesis

Herewith I declare that

- I am informed that Act No. 121/2000 Coll. – the Copyright Act, in particular, Section 35 – Utilisation of the Work as a Part of Civil Religious Ceremonies, as a Part of School Performances and the Utilisation of a School Work – and Section 60 – School Work, fully applies to my bachelor thesis;
- I take account of the VSB – Technical University of Ostrava (hereinafter as VSB-TUO) having right to utilize the bachelor thesis (under Section 35(3)) unprofitably and for own use;
- I agree that bachelor thesis shall be archived in the electronic form in VSB-TUO's Central Library and one copy shall be kept by the supervisor of the bachelor thesis. I agree that the bibliographic information about the bachelor thesis shall be published in VSB-TUO'S information system;
- It was agreed that, in case of VSB-TUO's interest, I shall enter into a license agreement with VSB-TUO, granting the authorization to utilize the work in the scope of Section 12(4) of the Copyright Act;
- It was agreed that I may utilize my work, the bachelor thesis or provide a license to utilize it only with the consent of VSB-TUO, which is entitled, in such a case, to claim an adequate contribution from me to cover the cost expended by VSB-TUO for producing the work (up to its real amount).

Ostrava dated 06.05.2016

Marie Dvořáková

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Student's name and surname